AdA204893

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

20030131217

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NCTRF 169	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Navy Clothing and Textile Research Facility 6b. OFFICE SYMBOL (If applicable) 20	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) 21 Strathmore Road Natick, MA 01760-2490	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO. 62-4-82

11. TITLE (Include Security Classification)

Cold-Weather Safety Boot (U)

12. PERSONAL AUTHOR(S)
Bailey, Milton

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM Jan 86 TO May 87	89 February	9

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	
23	04		Cold-Weather Safety Boot; Insulated Vapor Barrier; Steel Safety Toe; Military Protective Footwear; (KP)
11	07		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Navy Clothing and Textile Research Facility (NCTRF) developed a cold-weather safety boot (CWSB) containing an insulated vapor barrier and a steel safety toe to protect Navy personnel working ashore and afloat in frigid or subzero environments. The CWSB was evaluated against the standard cold-weather boot, which is identical in every respect, except for the steel safety toe. Both boots were found to be equal in insulating qualities for protection against the cold. The advantage of the CWSB, however, is that it also provides protection against impact of heavy objects. (U)

(type of military protective clothing)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL John A. Mylotte	22b TELEPHONE (Include Area Code) 508-651-4680 / 22c. OFFICE SYMBOL 00P

DD Form 1473, JUN 86 Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

COLD-WEATHER SAFETY BOOT

Introduction

Segments of the Fleet,including Construction Battalion and surface ship units, operating in frigid arctic environments ashore and afloat, wear Boots, Cold Weather, Insulated Rubber MIL-B-41816, Type I, Class 2, (see Figure 1) for protection against extreme wet/cold environments, including sub-zero Fahrenheit temperatures. Absent from this footwear are steel safety toes. Consequently personnel working in extremely cold environments without toe protection face the danger of serious injury should a heavy object fall on their toes. To protect personnel against this impact hazard, the Navy Clothing and Textile Research Facility (NCTRF) initiated the development of a cold weather safety boot (CWSB) under PE62758N that would provide the same level of toe protection afforded by conventional safety footwear worn in temperate environments. This report discusses the results of the CWSB evaluation in the laboratory and in the field (ashore and afloat).

Materials

Two suppliers, Miner Shoe Company, Bristol, RI, and Bata Shoe Company, Belcamp, MD, furnished 14 pair each of CWSBs in sizes ranging from 8 to 12. The boots were made according to Military Specification MIL-B-41816, Type I, Class 2, except that a steel safety toe was included. Both companies are also suppliers of the non-steel toe CWBs.

Test Procedures

Copper Foot Thermal Insulation Test - To determine whether any differences exist betwen the experimental CWSB and the standard CWB, a test was conducted on a 26-section Copper Foot (left foot) developed by the U.S.Army Research Institute of Environmental Medicine (USARIEM). Each section of the foot is identified in Figure 2. Insulation values (clo) for the the two boots (CWB and CWSB) were obtained on the Copper Foot which was fitted with a cushion sole sock and a size 10 test boot. No wind was present during the testing. No insulation values were obtained for the top ring of the foot (sections 1, 15, 23, 25), since the boot does not cover these sections of the Copper Foot. Toe impact and compression tests were performed according to ANSI Z 41.1.

Physiological Evaluation - Five male test participants wore the CWSB and CWB at 20 degrees F in a 4.5 mph wind for three hours. The participants also wore intermediate CW clothing which included the Navy work uniform, jacket, trousers, hat, gloves and wool socks. The participants sat during the first hour, walked at a speed of 3.5 mph on a level treadmill during the second hour, and rested again during the third hour. The varying temperatures of the big toe were measured using a Type T copper constantan thermocouple. Mean toe temperatures during the rest and walk periods were analyzed, using a repeated analysis of variance technique. The statistical significance of the differences were calculated at the five percent level (see Figure 3).

Wear Test

Great Lakes NTC: Eight pair of CWSBs were sent to Naval Construction Battalion Unit 401 (NCBU 401), Naval Training Center, Great Lakes, IL, where they were worn for several weeks by CB personnel operating in temperatures ranging from -20 degrees F (-30 degrees F with wind chill) to +28 degrees F in mud, ice and snow. Test participants compared CWSB with CWB which they normally wear during extreme cold weather.

USCG POLAR SEA (Coast Guard Ice Breaker): Ten Pair of CWSBs were worn for approximately one month at sea by Coast Guard Personnel operating in the Bering Sea under conditions of ice, snow and rain. Temperatures during the evaluation ranged from 18 to 36 degrees F, (mean temperature 28 degrees F), for approximately one month under conditions of ice, snow and rain.

Results and Discussion

The Copper Foot Data in Table I show little difference between the CWSB and CWB with respect to total clo values (CWSB 1.8 vs CWB 1.9). The toe sections 10, 11, 12 of Figure 2 (CWSB 1.9 vs CWB 2.0) indicate a trivial difference of 0.1 CLO. Impact and compression tests exceeded ANSI safety footwear standard of 75 foot-pounds and 2,500 pounds respectively.

Figure 3 depicts the results of the physiological evaluation which was conducted over a three-hour period. Results indicate no statistically significant differences at the five percent level in the sitting and walking modes between the CWSB AND CWB. These results support the findings of the Copper Foot. Results also indicate that the encapsulated steel toe should not significantly diminish the insulating effect of the CWSB.

CB personnel at Great Lakes NTC reported the CWSB to be thermally protective and to also provide good non-skid qualities. Although bulky, the CWSB was not judged excessive in weight. The test participants who worked for long periods of time on hillsides experienced no additional fatigue because of the CWSB.

Test participants aboard the Coast Guard ice breaker USCG POLAR SEA found the CWSB comfortable, warm, dry and protective against toe impacts. Results of the evaluation are presented in Table II.

Conclusion

Incorporation of the steel safety toe into the structure of the CWB, MIL-B-41816, Type I, hardly diminishes the essential insulating quality of this boot, but enhances the toe protective characteristics of the footwear. The findings suggest that the CWSB will be effective in providing both safety and warmth to the wearer in extreme cold weather environments.

Recommendation

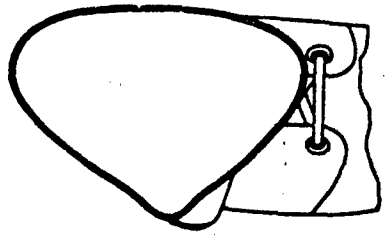
Further development testing be conducted under PE63514N to confirm the operational feasibility of the CWSB.

Table I

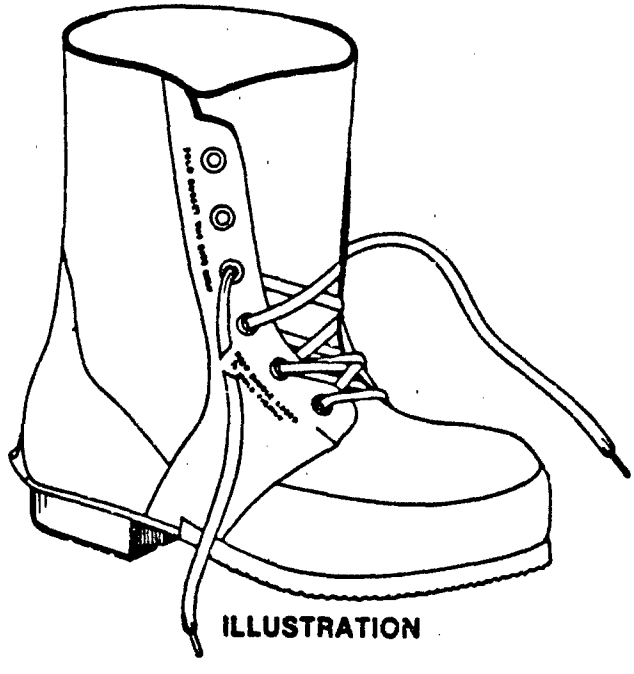
COMPUTED CLO VALUES OF TESTED FOOTWEAR

Section No.*	Steel Toe (clo)	No Steel Toe (clo)
2	1.1	1.2
3	1.3	1.3
4	2.1	2.2
5	1.5	1.6
6	2.0	2.0
7	1.8	1.7
8	2.1	2.0
9	1.4	1.4
10	1.4	1.4
11	2.2	2.3
12	1.6	1.7
13	2.6	2.7
16	1.2	1.1
17	1.5	1.4
18	1.8	1.8
20	1.6	1.5
21	1.8	1.6
22	1.1	1.2
26	1.4	1.3
27	1.6	1.5
28	1.6	1.6
29	1.5	1.6
Total clo:	1.8	1.9
Toes: (10, 11, 12)	1.9	2.0

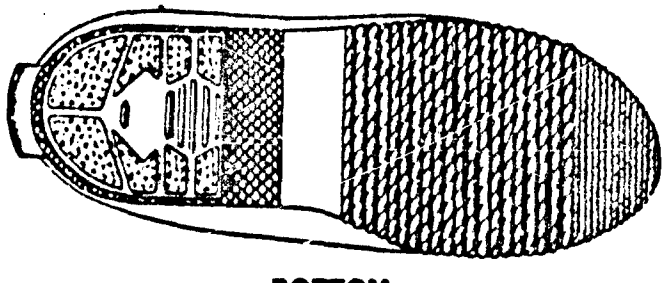
*See Figure 2 for identification of each numbered section.



TOP



ILLUSTRATION



BOTTOM

FIGURE 1. BOOTS, INSULATED, COLD WEATHER TYPE I, CLASS 2

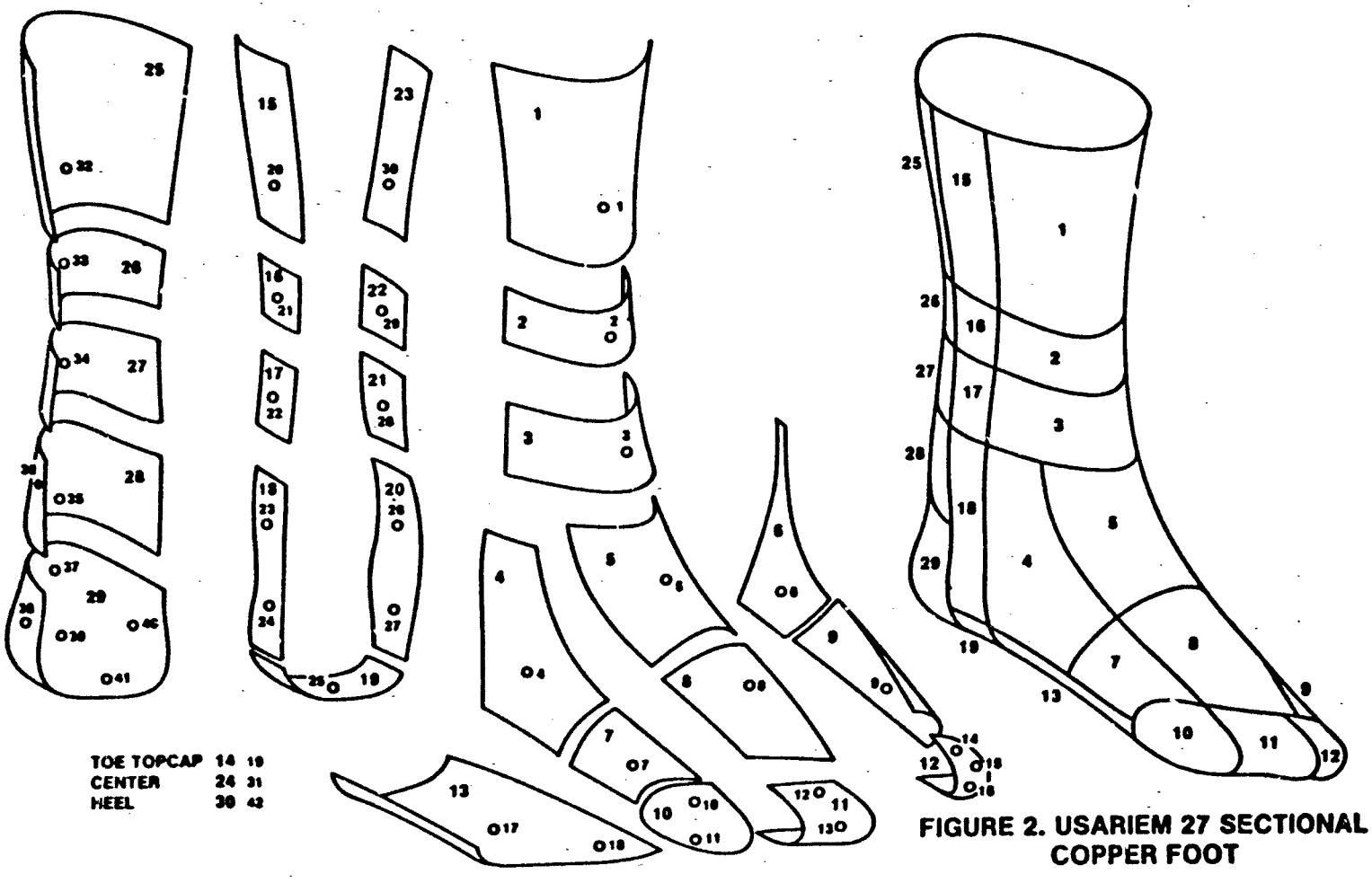


FIGURE 2. USARIEM 27 SECTIONAL COPPER FOOT

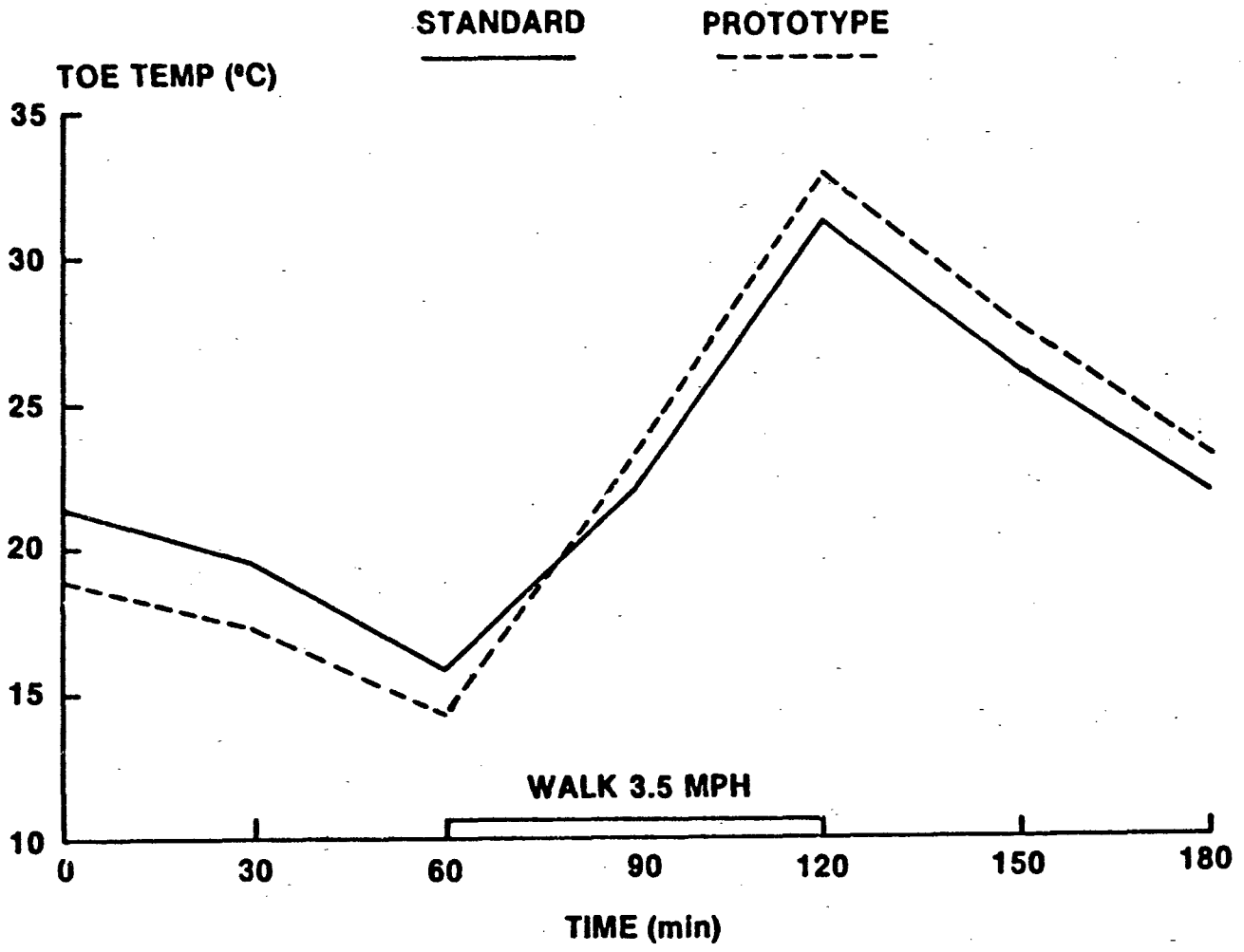


FIGURE 3. COLD WEATHER BOOT EVALUATION (-7°C/4.5 mph wind)